



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Southwest Fisheries Science Center  
Fisheries Ecology Division  
110 Shaffer Road  
Santa Cruz, California 95060

April 3, 2008

## CRUISE REPORT

**VESSEL:** NOAA Ship DAVID STARR JORDAN, DS-07-03

**CRUISE DATES:** MAY 4 - JUNE 17, 2007

**PROJECT:** Rockfish Recruitment Assessment,  
Fisheries Ecology Division, NOAA NMFS SWFSC

### BACKGROUND:

Rockfish (*Sebastes* spp.) are an important component of both the recreational and commercial fisheries off the west coast of North America. Many adult rockfish are often unavailable to commercial fishing gears until they are 3-7 years old, so a current preview of future stocks can be valuable in modeling population growth and determining allowable harvest levels. This can be accomplished by sampling rockfish during their pelagic juvenile stage. Since 1983, personnel from the Fisheries Ecology Division of the NOAA National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC), along with the NOAA Ship DAVID STARR JORDAN have conducted annual surveys off central California to assess the spawning success and future recruitment of various rockfish species. Starting in 2004 the survey's area expanded significantly, to include the entire area off California from Delgada in the north through San Diego in the south. In addition, Pacific whiting (*Merluccius productus*), a prominent groundfish fishery species, and krill (euphausiids) a key ecosystem prey species, are also sampled.

### ITINERARY:

#### ***LEG 1: May 4- May 14, 2007***

On May 3 scientific gear was staged on the Ship and the laboratories were setup the day prior to the planned departure. On May 4 the Ship was delayed from getting underway due to staffing needs. The Ship departed San Francisco at 0900 on May 5 and conducted sea trials for the Simrad ITI system, the mid-water trawl, the Simrad EK500, the Ship's Scientific Computer System (SCS), and the Conductivity-Temperature-Depth profiler (CTD) system. Normal trawling operations and CTD casts began on the night of May 5. From May 5 and until the morning of May 14 the Ship and scientists conducted mid-water trawls, CTD casts, GO-FLO deployments, EK500 bioacoustic recordings, Acoustic Doppler Current Profiler (ADCP) recordings, thermosalinometer recordings, SCUFA fluorometer recordings, and bird/marine mammal observations at stations along designated transects



between Monterey Bay and Delgada. Twenty-four hours were devoted to each transect. The transects covered during Leg 1, in chronological order, were; Monterey Inside, Monterey Outside, Davenport, Outside Farallones, Point Reyes, Fort Ross, Gulf of Farallones, and Pescadero.

#### ***LEG 2: May 14 - May 25, 2007***

An exchange of scientific personnel occurred on May 14 off Monterey Harbor. Beginning the night of May 14 and ending the morning of May 25 the Ship and scientists conducted operations similar to those during Leg 1, between San Francisco and San Diego. The transects covered during Leg 2, in chronological order, were: Piedras Blancas, Point Sal, San Miguel, San Nicolas, San Clemente, Monterey Bay Inside, Davenport, Pescadero, and Gulf of the Farallones. Conducted paired trawls with the Pacific Whiting Conservation Cooperative (PWCC) F/V EXCALIBUR at the Monterey Bay Inside, Davenport, and Pescadero transects. Conducted daylight hook and line fishing for adult groundfish at the San Miguel transect, San Clemente transect (Tanner Bank) and near Southeast Farallon Island at the Gulf of Farallones transect. Conducted opportunistic hook and line jigging for Humboldt squid (*Dosidicus gigas*) at the San Clemente transect. The Ship ended Leg 2, in San Francisco, at Pier 27 on May 25. An open house for congressional staff (Pelosi *et al*) was held on the Ship in the afternoon of May 25.

#### ***INPORT San Francisco Pier 27: May 26-27***

#### ***LEG 3: May 28 – June 8, 2007***

Scientists embarked the morning of May 28 and the Ship departed Pier 27, San Francisco. Beginning the night of May 28 and ending the morning of June 8 the Ship and scientists conducted operations similar to those during the previous legs. The transects covered during Leg 3, in chronological order, were: Point Reyes, Navarro, Delgada, Fort Ross, Farallones Outside, Monterey Bay Outside, Pescadero, Farallones Outside, Navarro, Delgada, and Point Reyes.

Also conducted ring net tows for Motomitsu Takahashi and opportunistically jigged for Humboldt squid during the nighttime CTD deployments.

#### ***LEG 4: June 8 - June 17, 2007***

Scientists, Ship's crewmembers, and frozen samples were exchanged the morning of June 8 at Pillar Point Harbor (Half Moon Bay). Beginning the night of June 8 and ending the morning of June 18, the Ship and scientists conducted operations similar to those during the previous legs. The transects covered during Leg 4, in chronological order, were: Monterey Bay Inside, PISCO Transect off Santa Cruz, Piedras Blancas, Point Sal, San Miguel, San Nicolas, San Clemente, and San Diego. Also conducted ring net tows for Motomitsu Takahashi and opportunistically jigged for Humboldt squid during the nighttime CTD deployments. Scientists and frozen samples disembarked the Ship the morning of June 17 in San Diego to end cruise DS-07-03. The Scientists returned to Santa Cruz the evening of June 17 via commercial airline. Scientific gear was shipped out of Scripps MARFAC, San Diego to Santa Cruz on June 18.

## **OBJECTIVES:**

1. Sample for pelagic juvenile rockfish and other epi-pelagic micronekton to determine their distribution and abundance between San Diego and Delgada.
2. Characterize prominent oceanographic features between San Diego and Delgada.
3. Map the distribution and abundance of krill along the continental shelf and shelf break.
4. Conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR, in cooperation with the NOAA NMFS Northwest Fisheries Science Center, in order to inter-calibrate the two vessels.
5. Collect pelagic juvenile rockfish for RNA:DNA and otolith microchemistry analysis.
6. Collect seawater for microchemical and nutrient analyses.
7. Observe seabird and marine mammal distribution and abundance.
8. Collect adult rockfish and Humboldt squid.
9. Conduct high-resolution mid-water trawls and daytime CTDs off Santa Cruz, in collaboration with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) recruitment monitoring/07 biophysical study.
10. Conduct ring net plankton tows for larval sardine (*Sardinops sagax*) and anchovy (*Engraulis mordax*) study in cooperation with Scripps Institution of Oceanography.
11. Opportunistically catch and save various fish and cephalopod specimens for NMFS SWFSC La Jolla, NOAA NMFS SWFSC Santa Cruz, Scripps Institution of Oceanography, New Mexico State University, University of California at Santa Cruz, and Hopkins Marine Station of Stanford University.

## **METHODS:**

1. Sample for pelagic juvenile rockfish and other epi-pelagic micronekton to determine the distribution and abundance between San Diego and Delgada:

In general, 5-7 midwater trawls, were conducted each night between 2100-0500 Pacific Standard Time at stations along mid-water trawling transects within the survey area, between San Diego and Delgada. Trawl stations remain in the same location and are sampled annually in a consistent manner. A list of the mid-water trawl and CTD stations appears in Appendix A and Figures 1 and 2 show the locations of standard trawl and CTD stations. Target headrope depths were achieved and maintained by a set amount of wire out for the trawl warps and a variable rate of speed through the water. Four SIMRAD ITI acoustic sensors (trawl-eye, depth-temp, port wing

spread, starboard wing spread) are attached to the headrope and to the net wings near the center of the breast lines during deployments. The SIMRAD ITI provided real-time information on headrope depth, footrope depth, distance between spread sensors, and seawater temperature at the headrope. The SIMRAD ITI information is refreshed and recorded on a 30 second interval. The standard target headrope depth is 30 m except in areas where the bottom is too shallow, in which case the target headrope depth is 7 m. For a target headrope depth of 30 m, 85 m of warp was used, while for a target headrope depth of 7 m, 25 m of warp was used. During mid-water trawl deployments (setting, fishing, retrieving), the Ship's speed was between 1.5-2.5 knots, (speed through the water). The Ship's speed and direction, during some tows, were altered to achieve the target headrope depth and for aligning of the codend directly astern of the Ship. In addition, a Vemco Temperature-Depth-Recorder (TDR) was also attached to the trawl net's headrope/bridle connection during deployments. The Vemco TDR provided retrospective data on depth and seawater temperature at the headrope. The Vemco TDR records this information every 10 seconds. The standard duration for fishing the trawl net at the target headrope depths was constant, at 15 minutes. In areas of high jellyfish concentrations, "test" trawl deployments were made of 5-minute duration. The fishing at target headrope depth begins when the designated amount of warp is out, with winches braked. All aft deck lights were turned off when the net was at target depth, so that no lights were visible when the net is fishing at depth. An acceptable, standard 30 m, target depth tow normally took 10 minutes to set and 10 minutes to retrieve. The standard tow direction was downwind with following seas astern. If both the wind and seas were calm then the tow direction was towards the next trawl station. In high crosscurrents, the course was altered into or with the current.

Fish, shrimp, cephalopods, and krill from each trawl were sorted, identified and enumerated. Juvenile rockfish, market squid, Humboldt squid stomachs and heads, selected juvenile groundfish, and juvenile salmon were frozen for laboratory analyses.

## 2. Characterize prominent oceanographic features between San Diego and Delgada:

CTD casts using the Ship's port J-frame were conducted throughout the day in the vicinity of the trawl transects and at each trawl station at night. Some CTDs were dropped during daytime and nighttime operations in the interests of the time needed to complete planned mid-water trawls. A Seabird Electronics SEACAT 19+ CTD and a SEACAT 19 CTD were used in conjunction with a Seabird Electronics Model 32/33 Carousel Water Sampling System. The CTD was lowered to a maximum depth of 520 m, or 10 m from the bottom, as bottom depth allowed. Deployment rate: soak CTD for 2 minutes at 10 m depth, then beginning at the surface, 45 m/min for the downcast, and 60 m/min for the upcast. Water samples were taken, on average, three times every 24 hours, for chlorophyll and nutrient samples. Water samples were collected during the upcast, with the Niskin Bottles, which were attached to the Seabird Electronics carousel.

An RDI ADCP recorded data continuously while underway to determine subsurface current velocity and direction. The hull mounted ADCP recorded horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the ocean. The CalCOFI ue4m.exe ADCP setup configuration was used to input navigational data from the Ship's GPS and gyrocompass into the ADCP Data

Acquisition Software (DAS). The ADCP transmits a ping from its transducer elements roughly once per second. Profiles were produced and displayed on a PC by range-gating the echo signal, which produces successive segments called depth bins. The noisy velocity estimates from each ping are vector averaged into ensembles.

A permanently mounted Seabird thermosalinometer continuously recorded seawater temperature and salinity while underway. The thermosalinometer measures water that is continually pumped from a seachest located in the Ship's hull at a water depth of 3 m. This data was used for comparisons with CTD casts, and for a nearly continuous recording of surface salinity and temperature. A Turner Designs SCUFA fluorometer was configured to record relative chlorophyll data continuously, while underway. The fluorometer was bench-mounted with a seawater flow-through system pumping seawater from the Ship's hull at a depth of 3 m. The seawater flow rate was 1000ml/12seconds (5000ml/minute). The fluorometer data was combined with the Ship's GPS location data and with date-time information via the Ship's SCS.

### 3. Map the distribution and abundance of krill along the continental shelf and shelf break:

A Simrad EK500 echo sounder was used to acoustically characterize the distribution and abundance of macro-zooplankton and micro-nekton, meroplankton and zooplankton. The echo sounder was configured with down-looking 38, 120, and 200 kilohertz (kHz) transducers mounted in the hull. During the survey, the EK500 was configured to transmit pulses every 2 seconds at 1 kilowatt for 1 millisecond duration. Geographic positions were obtained from the ship's GPS and logged every 60 seconds. Ethernet communications were maintained between the EK500 and a Windows based PC, which logged the EK500 telegrams using EchoLog software. Data were displayed in the aft lab using Sonardata's EchoView software.

Daytime EK500 transects, and daytime transits, with good EK500 acoustic-recording surface weather conditions, were carried out during the course of the survey. Daytime hoop net deployments near acoustic signatures were used to verify species of krill and to collect live specimens.

### 4. Conduct side-by-side paired vessels trawls with the PWCC F/V EXCALIBUR, in cooperation with the NOAA NMFS Northwest Fisheries Science Center, in order to compare the two surveys methodologies:

Several nights were spent conducting side-by-side paired vessel trawls with the PWCC F/V EXCALIBUR in order to compare the catches between the two surveys. The Ship and the F/V EXCALIBUR trawled at the same station within ¼ mile of each other. Trawling at each station started and ended at the same time with both vessels. Similar trawl nets were used on each of the research vessels and target headrope depths were matched. This was a cooperative effort between the NOAA NMFS SWFSC Fisheries Ecology Division, the NOAA NMFS Northwest Fisheries Science Center, and the PWCC.

### 5. Collect pelagic juvenile rockfish for RNA:DNA and otolith microchemistry analysis:

Subsamples of juvenile shortbelly rockfish (*S. jordani*) were collected with the mid-water trawl and were preserved in ultra-cold conditions within the first hour of capture for subsequent

RNA:DNA ratio analysis by Brian Wells and Kevin Stierhoff, postdoctoral associates of the NOAA NMFS SWFSC Fisheries Ecology Division.

6. Collect seawater for microchemical and nutrient analyses:

Seawater samples for trace chemical analysis were collected with a General Oceanics GO-FLO sampling bottle. A positive flow hood was setup and protective clothing was worn in order to handle the seawater samples and avoid contamination. Chemicals used on board included: clean water and 500 mL of 12M (35%) hydrochloric acid. At nearly every CTD station and trawl station a GO-FLO water-sampling bottle was deployed manually to 30 m depth. A hand-line attached to a down-rigger, along with a pulley was used to deploy the bottle along with a manual messenger. Once the water was collected, the unopened bottle was moved to the interior hood area. The seawater contents were placed into small sample bottles. Once the bottle sample was collected, it was acidified with a small drop of acid, placed in a small, labeled vial, and frozen for subsequent laboratory analysis.

Water samples were taken, on average, three times every 24 hours, for nutrient samples. Water samples were collected during the CTD deployment upcast, with the Niskin bottles, which were attached to the Seabird Electronics carousel. Seawater samples were frozen in scintillation vials for San Francisco State University's Romberg Tiburon Center.

7. Seabird and marine mammal observations:

PRBO Conservation Science ornithologists estimated the distribution and abundance of seabirds and marine mammals while underway during legs 1 and 2. Observers identified and counted birds/mammals continuously from the Ship's flying bridge during daylight hours while the vessel was underway at speeds of 7 knots (9 km/h) or greater. A range-finder was used to estimate the width of the survey transect and only those birds sighted within a 300 m arc from the bow (directly ahead) to 90 ° off the side with best visibility (e.g., least glare) were logged into a field computer. Ship-following birds were recorded the first time they were detected and were ignored thereafter. The observers estimated the range to marine mammal sightings and recorded them, regardless of their perpendicular distance to the vessel. Marine mammals were observed to the horizon. Distance and angle from the ship to each individual mammal or group of mammals were estimated. Data on marine mammals were entered as observations were made into a field computer.

8. Collection of adult rockfish and Humboldt squid:

The objective of this sampling was to collect genetic samples of the *Sebastes* subgenus, to better understand the genetics of blue rockfish of southern California and gopher rockfish of central California, and to collect otoliths from blue rockfish from southern California to help with age and growth studies. Hook and line fishing with rod /reel for adult rockfish species was conducted during daylight hours at different nearshore locations, in the southern California bight and near the Farallon Islands, to collect genetic samples of adult rockfish of the subgenus *Sebastes* (includes *S. chlorostictus*, *S. constellatus*, *S. ensifer*, *S. eos*, *S. helvomaculatus*, *S. lentiginosus*, *S. rosaceus*, *S. rosenblatti*, *S. simulator*, and *S. umbrosus*), blue rockfish, *S. mystinus*, and gopher rockfish, *S. carnatus*. Length, gender, and reproductive condition of gonads, were recorded for all fish captured. Otoliths, ovaries, and fin clips for genetic analysis

were removed from select specimens. A fingernail size tissue sample was removed from the anal or caudal fin and saved on blotter paper and stored in sample envelopes. In addition, selected whole fish specimens were frozen and brought back to the NOAA NMFS SWFSC Fisheries Ecology Division, Santa Cruz for ID confirmation. Locations of the fishing activity were determined by location of the Ship, available time, and operational constraints.

Hook and line fishing with rod/reel/jig was conducted opportunistically for Humboldt squid, *Dosidicus gigas*, whenever the squid were caught in the midwater trawl, during nighttime CTD deployments, or if squid were seen near the surface. Jigging gear was deployed over the port side of the ship with multiple rods & reels. Dip nets and gaffs were used to bring the squid aboard. Once the squid were aboard, the mantle lengths were measured, genders determined, and the stomachs and heads removed and frozen. Selected whole specimens were bagged and frozen.

9. Conduct high-resolution mid-water trawls and daytime CTDs off Santa Cruz, in collaboration with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) recruitment monitoring/07 biophysical study:

Mid-water trawls were performed on two consecutive nights off Santa Cruz, in collaboration with the PISCO recruitment monitoring/07 biophysical study. A high-resolution grid of CTD stations between Davenport and the northern edge of Monterey Bay were sampled during the daytime hours during the same period. Methods for the mid-water trawls and the CTD deployments were equivalent to the methods described under objective 1., listed above.

10. Conduct ring net plankton tows for larval sardine and anchovy study in cooperation with Scripps Institution of Oceanography:

Ring net plankton tows were conducted at opportunistic times during Legs 3 and 4 in order to capture potential prey items for larval anchovies and larval sardines (collected in the mid-water trawl) for Motomitsu Takahashi. The plankton tows normally occurred before the first mid-water trawl of the night and after the last mid-water trawl of the night. The plankton net was comprised of a 45 cm ring diameter with an attached 2 m long conic net (0.333 mm mesh). A 30-pound weight was attached to the net for deployment. Using the Ship's starboard hydrographic winch, the net was deployed vertically at selected mid-water trawl stations. The ship held station for the entire deployment of the plankton net. Descent wire rate was 36 m/minute. Total wire out was 150 m. Ascent wire rate was 60 m/minute. The catch from the tows were preserved in 10 % buffered formalin solution in glass jars.

11. Opportunistically catch and preserve various fish and cephalopod specimens for NMFS SWFSC, La Jolla, NOAA NMFS SWFSC, Santa Cruz, Scripps Institution of Oceanography, New Mexico State University, University of California at Santa Cruz, and Hopkins Marine Station of Stanford University:

Whole specimens of selected species of fish and cephalopods from the midwater trawl catches and from hook and line sampling were collected and frozen for subsequent dissemination to various researchers, after completion of the survey.

## RESULTS:

### 1. Juvenile Rockfish Survey:

A total of 162 successful nighttime midwater trawls were completed, at 77 different stations along the California coast, during the 4 Legs of the survey. Table 1 lists the total numbers of juvenile rockfish caught since 1986. Table 2 lists the catches of juvenile rockfish and Pacific whiting from the 2004, 2005, 2006, and 2007 surveys, based on catches north and south of Point Conception.

For the third year in a row, low catch rates of YOY rockfish were experienced off central and northern California. It would appear that 2007 was unfavorable for rockfish reproductive success off California north of Point Conception. The 2005 and 2006 surveys also showed unfavorable rockfish reproductive success in the central and northern California regions. Catches of rockfish north of Point Conception were slightly higher than the catches of 2005 and 2006, but were nearly an order of magnitude lower than the catch north of Point Conception during the 2004 survey. 2004 was the first year that the survey expanded its range into the southern California Bight. Catch rates for pre-recruit rockfish south of Point Conception were higher than those of the 2004 and 2006 surveys, mostly due to the relatively large number of YOY Sebastomus and Greenstriped rockfish caught during the survey. The overall catch for pre-recruit rockfish south of Point Conception during 2007 was much lower than the catch south of Point Conception in 2005, mostly due to the significant decrease in catches of shortbelly rockfish and half-banded rockfish. Diversity of the YOY rockfish catch south of Point Conception has remained similar from 2004 through 2007, whereas north of Point Conception the diversity has shown more heterogeneity, with lower diversities during the 2005 and 2006 surveys, and higher diversities during the 2004 and 2007 surveys.

Catches of Pacific whiting during the 2007 survey mimicked the 2006 survey in the total catch of the species. The 2007 catches also mimicked the 2006 survey in that catches were higher north of Point Conception than south of the Point. This is opposite of what was observed during the 2005 survey, in which catches of Pacific whiting were much higher south of Point Conception than north of the Point. The 2004 survey also showed higher catches to the north of Point Conception, but to a much higher degree than either 2006 and 2007, with catches north of Point Conception being nearly 2 orders of magnitude higher than catches to the south. Overall catches of Pacific whiting throughout the entire survey area, during 2006 and 2007 were relatively low, compared to the surveys of 2004 and 2005.



**Table 1. Number of YOY rockfish (*Sebastes spp.*) collected at stations by mid-water trawls during surveys (1986-2007)**

SPECIES	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Shortbelly	9104	6865	107962	1598	4479	2422	2838	2287	949	276	1848	784	69	124	2016	3403	995	206	1235	6412	220	1213
Chilipepper	54	586	4418	24	66	343	90	1251	3	32	17	12	3	27	27	126	286	85	212	10	1	6
Brown	470	10	-	3	19	265	7	1226	15	5	32	2	-	2	5	117	58	95	27	2	-	9
Widow	11	424	257	13	296	623	1	101	24	25	-	49	1	81	80	193	858	227	1247	-	-	23
Squarespot	4	177	380	16	649	47	70	25	2	-	-	1	-	-	-	36	16	1	14	896	178	742
Canary	46	71	162	39	23	618	-	14	3	-	-	3	-	38	9	31	258	31	314	2	-	75
Blue	4	196	366	63	38	220	3	38	11	7	4	5	-	9	10	67	341	140	468	-	-	17
Stripetail	2	194	30	6	22	175	5	315	9	6	2	27	14	31	11	185	352	18	213	4	1	7
Bocaccio	327	106	60	22	44	114	5	26	4	3	1	7	1	15	24	51	71	2	35	96	6	28
Yellowtail	22	85	69	31	27	281	5	31	8	27	3	6	6	1	10	30	58	68	838	-	2	1
Copper complex	9	9	1	-	1	15	116	82	54	7	10	42	4	2	4	25	5	-	5	7	1	74
Halfbanded	1	9	-	2	77	8	1	5	2	-	6	68	-	1	-	96	7	-	4	1405	3	41
Pygmy	2	15	9	12	10	62	8	2	3	-	1	2	-	1	3	34	37	8	25	103	21	101
Black	1	22	19	5	4	34	-	6	2	7	7	-	1	5	1	2	29	23	294	-	-	1
Olive	-	4	2	6	18	-	-	6	1	-	-	-	-	-	-	13	5	-	7	1	-	1
Darkblotched	-	7	5	-	1	9	-	9	-	2	-	-	-	2	1	1	6	3	19	-	-	4
Cowcod	1	17	1	1	-	-	5	5	-	-	-	-	-	-	-	-	2	1	5	7	2	3
Bank	-	18	4	-	-	-	-	5	-	-	-	-	-	-	1	1	3	-	1	6	1	13
Sebastomus	2	7	3	-	1	3	8	-	-	1	2	27	-	-	2	2	2	3	423	492	1050	2130
Splitnose	1	4	-	-	1	-	19	-	-	-	-	10	-	1	3	-	-	-	1	1	1	8
Puget Sound	-	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharpchin	-	-	-	-	-	-	2	-	14	-	-	-	-	1	-	1	3	-	-	1	-	2
Grass	1	1	-	-	-	-	8	2	1	-	-	-	2	-	-	3	-	-	-	-	-	-
Quillback	2	1	-	-	-	6	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
Vermillion	-	4	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	1	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-
Greenspotted	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Greenstriped	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	25	43	437
Blackgill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	18	71	146
Aurora	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	1	1	5
Calico	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Yelloweye	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Unknown	40	5	-	-	2	4	49	31	13	13	31	49	14	25	29	55	2	45	337	1627	-	1485
<b>Totals</b>	<b>10104</b>	<b>8837</b>	<b>113748</b>	<b>1841</b>	<b>5779</b>	<b>5290</b>	<b>3242</b>	<b>5467</b>	<b>1120</b>	<b>411</b>	<b>1971</b>	<b>1095</b>	<b>115</b>	<b>366</b>	<b>2236</b>	<b>4472</b>	<b>3394</b>	<b>957</b>	<b>5818</b>	<b>11113</b>	<b>1603</b>	<b>6572</b>

**Table 2. Pelagic juvenile rockfish (*Sebastes spp.*) and Pacific whiting (*Merluccius productus*) catches south and north of Point Conception during the rockfish surveys of 2004, 2005, 2006, and 2007**

<b>Rockfish Species</b>	<b>South 2004</b>	<b>South 2005</b>	<b>South 2006</b>	<b>South 2007</b>	<b>North 2004</b>	<b>North 2005</b>	<b>North 2006</b>	<b>North 2007</b>
Shortbelly	100	6388	142	804	1135	22	78	409
Squarespot	74	932	178	742	7	-	-	-
Halfbanded	2	1410	3	40	4	-	-	1
Bocaccio	14	96	6	17	22	-	-	11
Greenstriped	36	25	43	437	-	-	-	-
Blackgill	63	18	71	146	-	-	-	-
Cowcod	4	7	2	3	1	-	-	-
Bank	4	10	1	13	1	-	-	-
Splitnose	2	1	1	8	-	-	-	-
Aurora	2	1	1	5	-	-	-	-
Copper Complex	4	7	1	73	4	-	-	1
Sebastes spp.	433	491	1050	2130	3	1	-	-
Sharpchin	2	-	-	1	-	1	-	1
Speckled	1	-	-	-	-	-	-	-
Calico	-	4	-	-	-	-	-	-
Pygmy	66	82	17	85	17	24	4	16
Stripetail	1	3	-	-	212	3	1	7
Brown	-	2	-	-	27	-	-	9
Chilipepper	-	9	-	1	212	2	1	5
Olive	-	-	-	-	7	1	-	-
Darkblotched	-	-	-	-	19	-	-	4
Widow	-	-	-	-	1248	-	-	23
Yellowtail	-	-	-	-	838	-	3	1
Black	-	-	-	-	294	-	-	1
Blue	-	-	-	-	470	-	-	17
Canary	-	-	-	-	314	2	-	75
Yelloweye	-	-	-	1	-	-	-	-
<b>Total Catch</b>	<b>808</b>	<b>9486</b>	<b>1516</b>	<b>4506</b>	<b>4835</b>	<b>56</b>	<b>87</b>	<b>581</b>

<b>Species</b>	<b>South 2004</b>	<b>South 2005</b>	<b>South 2006</b>	<b>South 2007</b>	<b>North 2004</b>	<b>North 2005</b>	<b>North 2006</b>	<b>North 2007</b>
Pacific Whiting	636	13062	234	452	46919	91	2013	1295

## 2. Physical Oceanographic Data Collections:

267 CTD casts were completed during the survey. All of the CTD casts successfully collected chlorophyll and turbidity data at deployed depths along with salinity and temperature data. Collection of accurate chlorophyll data at the surface layer along the Ship's track was problematic due to a faulty SCUFA fluorometer. The Seabird thermosalinometer collected surface temperature and salinity data along the ship's track throughout the survey. The Ship's ADCP collected subsurface current data along the Ship's track throughout the survey. Surface weather conditions were variable throughout the survey. Periods of upwelling favorable conditions with strong equatorward winds were present during all four legs of the survey and were separated by relaxation events with light to calm wind conditions. Leg 1 was dominated by upwelling favorable conditions, while the Ship operated off central and northern California, with a three day relaxation event halfway through the Leg. Surface water temperatures off central California dropped below 9 °C during Leg 1 and the upper water column was well mixed in the northern half of the survey area. Leg 2 had upwelling favorable conditions during most of the Leg while the Ship operated in southern and central California. Northerly gales were also experienced during Leg 2 in both southern and central California waters, before a relaxation event occurred at the end of that Leg. Light to calm winds continued into Leg 3 and dominated the surface weather during Legs 3 and 4. Of the 20 days underway during Legs 3 and 4 in which all of the transects, throughout the survey's area, were sampled, only 4 days saw upwelling favorable conditions. The other 16 days of operations had light to calm winds.

## 3. Map the Distribution and Abundance of Krill Along the Continental Shelf and Shelf Break:

Bioacoustic data from the Simrad EK500 were collected during Leg 2, 3, and 4 of the survey. Acoustic data are being used for various studies cooperatively between the NOAA NMFS Fisheries Ecology Division, the Point Reyes Bird Observatory Conservation Science, and the University of California, Santa Cruz, which include acoustic target identification and differentiation, and krill abundance/distribution. Data collected during the daylight hours under relatively low swell and sea wave height conditions, being the most valuable for the krill research. Data from the EK500 were not recorded to computer disk during Leg 1 due to an oversight in the initial setup of the data recording method.

## 4. Paired trawls with the PWCC F/V EXCALIBUR:

18 paired trawls over 3 nights at 3 different transects were successfully completed. The nights of paired trawling occurred near the end of Leg 2 from May 21-24. The transects occupied during the paired trawling, in chronological order were the Monterey Bay Inside, Davenport, and Pescadero transects. 6 total trawls were completed on each of the three nights. The second and third nights of the paired trawling were conducive to inter-vessel comparisons due to the fact that back-to-back trawls were completed at 3 stations per night (e.g. 6 total trawls per transect per night, with 3 stations only per transect).

## 5. Collect pelagic juvenile rockfish for RNA:DNA analysis:

Muscle tissue was collected from 200 juvenile shortbelly rockfish for RNA:DNA analysis. RNA:DNA ratios serve as a proxy for recent growth, and can therefore be used to examine temporal and spatial patterns of growth relative to prevailing oceanographic conditions (e.g. upwelling intensity, primary productivity, temperature). We have no results from this work yet.

#### 6. Collection of seawater for microchemical and nutrient analyses:

Two hundred GO-FLO bottle water samples were collected for microchemical analysis. Otoliths were collected from 200 juvenile shortbelly rockfish for microchemical analysis. In particular, this objective sought to describe differences in microchemical signatures (e.g., Ba, Sr, Mg, Mn, Cd, and Li) from various water masses stretching from just north of Point Reyes to Point Sur in the south, with the ultimate goal of matching water chemistry to otolith chemistry of juvenile shortbelly rockfishes. Preliminary analyses indicate that one can discriminate between five distinct water masses (based on oceanographic conditions, such as upwelling intensity) with about 70% confidence. These results suggest that one should be able to also detect such differences in otolith chemistry of juvenile shortbelly rockfish. Similarities between otolith chemistry and water chemistry will be used to examine potential transport pathways, transport times, and to explain temporal and spatial differences in growth rate (based on otolith increment analysis and RNA:DNA ratios) of pelagic rockfish.

Seawater samples were collected at discrete depths for nutrient analysis in cooperation with San Francisco State University's Romberg Tiburon Center. The seawater samples were collected during CTD casts, frozen in scintillation vials, and delivered to San Francisco State University. More samples were targeted and taken near the Gulf of the Farallones and Point Reyes than at any other transects, although water samples were collected consistently off central/northern CA.

#### 7. Seabird and Marine Mammal Observations:

PRBO Conservation Science conducted observations of marine birds and mammals from the flying bridge during all daylight hours during Legs 1 and 2. Observations of the most numerous species for the period are summarized in Table 3 and Table 4. A total of 56 species of seabirds and marine mammals were identified, and over 26,800 individuals were enumerated. Relatively large numbers of black-footed albatrosses, phalaropes and humpback whales were highlights. Many Horned Puffins were also seen but most were outside of the standard transect width.

**Table 3. Observations of seabirds on legs 1 & 2**

<b>SEABIRD SPECIES OBSERVED</b>	<b># OBSERVED</b>	<b>% OF TOTAL OBSERVED</b>
Red-Necked Phalarope	7106	27.72
Common Murre	4414	17.22
Sooty Shearwater	4162	16.23
Red Phalarope	3739	14.58
Western Gull	1397	5.45
Cassin's Auklet	1339	5.22
Brandt's Cormorant	1061	4.13
Rhinoceros Auklet	586	2.28
Pink-Footed Shearwater	568	2.21
Unidentified Phalarope	323	1.26
Black-Footed Albatross	276	1.07
California Gull	195	0.76
Pacific Loon	87	0.33
Sabine's Gull	69	0.26
Xantus's Murrelet	51	0.19
Unidentified Seabird	48	0.18
Common Merganser	30	0.11
Northern Fulmar	27	0.10
Brown Pelican	26	0.10
Surf Scoter	22	0.08
Common Loon	18	0.07
Black Storm-Petrel	17	0.06
Pigeon Guillemot	14	0.05
Tufted Puffin	6	0.02
Arctic Tern	5	0.01
Double-crested Cormorant	5	0.01
Fork-tailed Storm-Petrel	5	0.01
Bonaparte's Gull	4	0.01
Caspian Tern	4	0.01
Elegant Tern	4	0.01
Pomarine Jaeger	3	0.01
Red-throated Loon	3	0.01
Ancient Murrelet	2	0.007
Ancient Murrelet	2	0.007
Horned Puffin	2	0.007
Laysan Albatross	2	0.007
Parasitic Jaeger	2	0.007
Black-vented Shearwater	1	0.0039
Dark-rumped Petrel	1	0.0039
Glaucous-winged Gull	1	0.0039
Herman's Gull	1	0.0039
Leach's Storm-Petrel	1	0.0039
Red-billed Tropicbird	1	0.0039
Western Grebe	1	0.0039
<b>Total Seabirds</b>	<b>25631</b>	

**Table 4. Observations of marine mammals on legs 1 & 2**

<b>MAMMAL SPECIES OBSERVED</b>	<b># OBSERVED</b>	<b>% OF TOTAL OBSERVED</b>
California Sea Lion	784	69.19
Northern Right Whale Dolphin	51	4.50
Fin Whale	14	1.23
Risso's Dolphin	31	2.73
Dall's Porpoise	68	6.00
Harbor Seal	2	0.17
Humpback Whale	51	4.50
Northern Elephant Seal	6	0.52
Northern Fur Seal	23	2.03
Pacific Whitesided Dolphin	73	6.44
Sea Otter	1	0.09
Unidentified Whale	17	1.50
Unidentified Dolphin	4	0.35
Unidentified Seal	7	0.62
Unidentified Sea Lion	1	0.09
<b>Total Mammals</b>	<b>1133</b>	

**8. Collection of adult rockfish and Humboldt squid:**

Four days were spent hook and line fishing, three days in the Channel Islands and one day near the Southeast Farallon Island. A total of 344 fish from 16 species were captured. Of those, 66 were blue rockfish from southern California. A total of 53 fish from 3 species of the *Sebastes* group were obtained for subsequent laboratory genetic workup.

Humboldt squid were caught at various stations throughout the survey during trawl operations and by jigging with rod/reel gear. For the third year in a row Humboldt squid were caught in the midwater trawl during normal nighttime operations. Two squid were caught in a single trawl at the Pescadero transect during Leg 3. Forty-two Humboldt squid were opportunistically caught with squid jigs on rod & reel gear over the course of the survey. Mantle lengths were measured, stomachs, and heads of the squid were collected from all specimens caught and frozen for post cruise processing and analysis. Whole squid specimens were also frozen for laboratory analyses. Various squid forage species, which were caught in the midwater trawls that occurred in the vicinity of jig-caught squid, were frozen and delivered to NMFS SWFSC, Santa Cruz.

**9. Conduct high-resolution mid-water trawls and daytime CTDs off Santa Cruz, in collaboration with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) recruitment monitoring/07 biophysical study:**

Seven mid-water trawls were performed on two nights off Santa Cruz, in collaboration with the PISCO recruitment monitoring/07 biophysical study. A high-resolution grid of CTD stations

between Davenport CA and the northern edge of Monterey Bay were sampled during the daytime hours during the same dates. Methods for the mid-water trawls and the CTD deployments were equivalent to the methods described under objective 1, which is listed above.

10. Conduct ring net plankton tows for larval sardine and anchovy study in cooperation with Scripps Institution of Oceanography:

Over 40 ring net plankton samples were collected and preserved, for Motomitsu Takahashi, during Legs 3 and 4. Most all of the ring net tows occurred at the beginning of each night before the first midwater trawl and at the end of each night after the last midwater trawl. The preserved plankton samples were taken to Scripps Institution of Oceanography at the conclusion of the survey by Motomitsu Takahashi upon disembarkation in San Diego.

11. Opportunistically catch and save various fish and cephalopod specimens for NMFS SWFSC, La Jolla, NOAA NMFS SWFSC, Santa Cruz, Scripps Institution of Oceanography, New Mexico State University, University of California at Santa Cruz, and for Hopkins Marine Station of Stanford University:

Whole specimens of selected species of fish and cephalopods from trawl catches and from hook & line sampling were collected and frozen for subsequent dissemination to various researchers and laboratory analyses after completion of the survey.

Market Squid (*Loligo opalescens*) have been collected consistently for the University of California, Santa Cruz since 2000. A total of 2467 Market squid were caught during the survey. Table 5 lists the total catch numbers for market squid during the surveys since 1987, which was the first year that market squid were identified and enumerated. The number of market squid caught in the midwater trawls was relatively low compared to previous surveys. In comparison to last year, nearly three times as many were caught, but the catches were still low in comparison to most years since 1987. 2007 was very similar to the 2005 catch of market squid.

**Table 5. Total number of market squid caught during surveys (1987-2007)**

YEAR	TOTAL CATCH
1987	33906
1988	14082
1989	7929
1990	5242
1991	74719
1992	45308
1993	9396
1994	4460
1995	11684
1996	4014
1997	6055
1998	240
1999	1140
2000	5199
2001	26407
2002	8721
2003	2002
2004	5248
2005	2526
2006	835
2007	2467

## DISPOSITION OF DATA:

1. Juvenile rockfish specimens, midwater trawl catch data, CTD, SIMRAD EK500, chlorophyll, thermosalinometer, ADCP, data - Keith Sakuma, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
2. Adult rockfish data - Don Pearson, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
3. Ship's logistics information, staffing, and sampling station information - Ken Baltz, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
4. Seabird and marine mammal data - Bill Sydeman, Point Reyes Bird Observatory, 4990 Shoreline Hwy, Stinson Beach, CA 94970 (wsydeman@faralloninstitute.org, 707-478-1381).
5. Humboldt squid data - John Field, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
6. GO-FLO data - Brian Wells, NOAA NMFS SWFSC Fisheries Ecology Division, 110 Shaffer Road, Santa Cruz CA 95060.
7. Ring net tow data – Motomitsu Takahashi, Scripps Institution of Oceanography, 8602 La Jolla Shores Drive, La Jolla, CA 92037, Attn: Motomitsu Takahashi, Phone: 858-822-2773.



## **SCIENTIFIC PERSONNEL:**

### ***Leg 1 (May 4 - May 14)***

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)  
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)  
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA  
Steve Ralston, Fish Biologist, NMFS, Santa Cruz, CA  
Heidi Fish, Fish Biologist, NMFS, Santa Cruz, CA  
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA  
Kevin Stierhoff, Post-Doc, UCSC and NMFS, Santa Cruz, CA  
Ben Cook, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA  
Lisa Sheffield, PRBO Conservation Science, Stinson Beach, CA  
Sophie Webb, PRBO Conservation Science, Stinson Beach, CA  
Valerie Green, San Francisco State University, Romberg Center, Tiburon, CA

### ***Leg 2 (May 14 - May 25)***

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)  
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)  
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA  
Christine Peterson, Post-Doc, NMFS, Santa Cruz, CA  
Kevin Stierhoff, Post-Doc, UCSC and NMFS, Santa Cruz, CA  
Sean Noble, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA  
Kathy Preston, University of California, Santa Cruz, Santa Cruz, CA  
Lisa Sheffield, PRBO Conservation Science, Stinson Beach, CA  
Sophie Webb, PRBO Conservation Science, Stinson Beach, CA

### ***Leg 3 (May 28 – June 8)***

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)  
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)  
Don Pearson, Fish Biologist, NMFS, Santa Cruz, CA  
Ben Cook, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA  
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA  
Lindsay Starrett, University of California, Santa Cruz, Santa Cruz, CA  
Kate Cresswell, Post Doc, University of California, Santa Cruz, Santa Cruz, CA  
Motomitsu Takahashi, Post-Doc, Scripps Institution of Oceanography, San Diego, CA

### ***Leg 4 (June 8 - June 17)***

Ken Baltz, Oceanographer, NMFS, Santa Cruz, CA (Cruise Leader)  
Keith Sakuma, Fish Biologist, NMFS, Santa Cruz, CA (Chief Scientist)  
Joshua Bauman, NOAA Corps -Fish Biologist, NMFS, Santa Cruz, CA  
Baldo Marinovic, Krill Biologist, University of California, Santa Cruz, Santa Cruz, CA  
Brian Wells, Post-Doc, NMFS, Santa Cruz, CA  
Danielle Lipski, NOAA NOS, Channel Islands NMS, Santa Barbara, CA  
Motomitsu Takahashi, Post-Doc, Scripps Institution of Oceanography, San Diego, CA

# JUVENILE ROCKFISH MIDWATER TRAWL AND CTD STATIONS

## DAY: CTD - SAN DIEGO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 42.5'	117° 27'	350	340	4041
CTD	32° 47.9'	117° 37'	1020	520	4042
CTD	32° 54.5'	117° 46.7'	1040	520	4043
CTD	33° 08'	117° 42'	810	520	4045
CTD	33° 02'	117° 32.3'	700	520	4046
CTD	32° 54.4'	117° 23'	550	520	4047

## NIGHT: TRAWL & CTD - SAN DIEGO

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 01'	117° 45'	750	520	481
trawl	33° 01'	117° 45'	750	85	481
CTD	32° 55'	117° 35'	850	520	482
trawl	32° 55'	117° 35'	850	85	482
CTD	32° 49'	117° 25.3'	700	520	483
trawl	32° 49'	117° 25.3'	700	85	483
trawl	32° 42.5'	117° 20'	100	85	484
CTD	32° 42.5'	117° 20'	100	90	484

## DAY: CTD - SAN CLEMENTE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 43'	117° 57'	520	510	4048
CTD	32° 33'	117° 57'	963	520	4049
CTD	32° 33'	118° 09'	1900	520	4050
CTD	32° 33'	118° 21'	1385	520	4051
CTD	32° 33'	118° 33'	1111	520	4052

## NIGHT: TRAWL & CTD - SAN CLEMENTE

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	32° 43'	118° 09.3'	1000	520	401
trawl	32° 43'	118° 09.3'	1000	85	401
CTD	32° 43'	118° 27.2'	270	260	402
trawl	32° 43'	118° 27.2'	270	85	402
CTD	32° 43'	118° 44.9'	1284	520	403
trawl	32° 43'	118° 44.9'	1284	85	403
trawl	32° 43'	119° 03'	500	85	404
CTD	32° 43'	119° 03'	500	490	404

## DAY: CTD - SAN NICOLAS

<i>OPS</i>	<i>Latitude</i>	<i>Longitude</i>	<i>Depth(m)</i>	<i>Wire Out(m)</i>	<i>Station</i>
CTD	33° 24.4'	119° 24.2'	963	520	4002
CTD	33° 20.2'	119° 32.5'	85	75	4003
CTD	33° 12.6'	119° 44.3'	460	450	4004
CTD	33° 32.5'	119° 51.4'	330	320	4006
CTD	33° 37.8'	119° 41.6'	1366	520	4007
CTD	33° 44.6'	119° 32.5'	1930	520	4008

NIGHT: TRAWL & CTD - SAN NICOLAS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	33° 41.4'	119° 17.2'	886	520	411
trawl	33° 41.4'	119° 17.2'	886	85	411
CTD	33° 35.2'	119° 26.9'	1874	520	412
trawl	33° 35.2'	119° 26.9'	1874	85	412
CTD	33° 29.2'	119° 36.3'	769	520	413
trawl	33° 29.2'	119° 36.3'	769	85	413
trawl	33° 23'	119° 45.8'	107	85	414
CTD	33° 23'	119° 45.8'	107	97	414

DAY: CTD - SAN MIGUEL

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	33° 49.3'	120° 33.1'	1819	520	4010
CTD	34° 01.8'	120° 51.6'	948	520	4011
CTD	34° 09.8'	120° 44.6'	738	520	4012

NIGHT: TRAWL & CTD - SAN MIGUEL

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	33° 55.1'	120° 42.7'	1848	520	425
trawl	33° 55.1'	120° 42.7'	1848	85	425
CTD	34° 04.2'	120° 34.7'	159	150	424
trawl	34° 04.2'	120° 34.7'	159	85	424
CTD	34° 10.6'	120° 28.3'	149	140	423
trawl	34° 10.6'	120° 28.3'	149	85	423
trawl	34° 18.9'	120° 18'	355	85	422
CTD	34° 18.9'	120° 18'	355	345	422

DAY: CTD - PT. SAL

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	35° 07'	120° 44'	38	30	4070
CTD	35° 07'	120° 53.5'	154	144	4069
CTD	35° 07'	121° 03'	457	447	4068
CTD	35° 07'	121° 12.6'	579	520	4067
CTD	34° 52'	121° 12.6'	564	520	4066
CTD	34° 52'	121° 03'	415	105	4065
CTD	34° 52'	120° 53.5'	221	211	4064
CTD	34° 52'	120° 44'	62	52	4063

NIGHT: TRAWL & CTD - PT. SAL

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	35° 00'	120° 44'	55	45	491
trawl	35° 00'	120° 44'	55	25	491
CTD	35° 00'	120° 47.6'	94	84	492
trawl	35° 00'	120° 47.6'	94	85	492
CTD	35° 00'	120° 53'	192	182	493

trawl	35° 00'	120° 53'	192	85	493
CTD	35° 00'	120° 58.5'	374	364	494
trawl	35° 00'	120° 58.5'	374	85	494
trawl	35° 00'	121° 07'	543	85	495
CTD	35° 00'	121° 07'	543	520	495

DAY: CTD - PIEDRAS BLANCAS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	35° 32.1'	121° 21.8'	516	506	4023
CTD	35° 32.1'	121° 34.1'	848	520	4024
CTD	35° 32.1'	121° 46.3'	1007	520	4025
CTD	35° 52'	121° 46.4'	968	520	4028
CTD	35° 52'	121° 34'	510	500	4029

NIGHT: TRAWL & CTD - PIERAS BLANCAS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	35° 42.2'	121° 21.8'	60	50	441
trawl	35° 42.2'	121° 21.8'	60	85	441
CTD	35° 42.2'	121° 25.8'	167	155	442
trawl	35° 42.2'	121° 25.8'	167	85	442
CTD	35° 42.2'	121° 30.5'	557	520	443
trawl	35° 42.2'	121° 30.5'	557	85	443
CTD	35° 42.2'	121° 42'	885	520	444
trawl	35° 42.2'	121° 42'	885	85	444
trawl	35° 42.2'	121° 52'	1040	85	445
CTD	35° 42.2'	121° 52'	1040	520	445

NIGHT: TRAWL & CTD - MONTEREY BAY INSIDE

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	36° 50.8'	121° 59'	91	81	119	
trawl	36° 50.8'	121° 59'	91	85	119	MI
CTD	36° 46'	121° 52'	73	63	114	
trawl	36° 46'	121° 52'	73	85	114	MI
CTD	36° 44.4'	121° 58.6'	238	228	116	
trawl	36° 44.4'	121° 58.6'	238	85	116	MI
CTD	36° 42.5'	121° 54.5'	91	81	115	
trawl	36° 42.5'	121° 54.5'	91	85	115	MI
CTD	36° 38.5'	121° 51.5'	37	30	111	
trawl	36° 38.5'	121° 51.5'	37	25	111	MI
trawl	36° 39.3'	121° 56.8'	73	85	112	MI
CTD	36° 39.3'	121° 56.8'	73	63	112	

DAY: CTD - MONTEREY BAY OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	36° 40'	122° 10'	1134	520	1002
CTD	36° 46.3'	122° 16.1'	823	520	1003
CTD	36° 46.3'	122° 28.4'	2103	520	1004
CTD	36° 40'	122° 22.3'	1737	520	1005
CTD	36° 33.7'	122° 16.2'	2560	520	1006

CTD	36° 33.7'	122° 28.4'	2743	520	1007
CTD	36° 40'	122° 34.6'	2377	520	1008
CTD	36° 46.3'	122° 40.7'	2149	520	1009
CTD	36° 33.7'	122° 40.7'	2743	520	1010

NIGHT: TRAWL & CTD - MONTEREY BAY OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	36° 35'	122° 10.5'	2323	520	110	
trawl	36° 35'	122° 10.5'	2323	85	110	MO
trawl	36° 35'	122° 10.5'	2323	25	110	MO
CTD	36° 35'	122° 02'	530	520	109	
trawl	36° 35'	122° 02'	530	85	109	MO
CTD	36° 38.8'	122° 03'	914	520	113	
trawl	36° 38.8'	122° 03'	914	85	113	MO
CTD	36° 42'	122° 06.5'	1920	520	117	
trawl	36° 42'	122° 06.5'	1920	85	117	MO
trawl	36° 46.4'	122° 09'	914	85	118	MO
CTD	36° 46.4'	122° 09'	914	520	118	

DAY: CTD - DAVENPORT

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	36° 52.6'	122° 10'	91	81	1011
CTD	36° 52.6'	122° 22.3'	823	520	1012
CTD	36° 52.6'	122° 34.6'	1600	520	1013
CTD	36° 52.6'	122° 47'	2286	520	1014
CTD	36° 52.6'	122° 59.3'	2697	520	1015
CTD	36° 59'	122° 53'	1372	520	1016
CTD	37° 05'	122° 47'	686	520	1017
CTD	37° 05'	122° 34.6'	119	110	1018
CTD	37° 05'	122° 22.3'	59	50	1019

NIGHT: TRAWL & CTD - DAVENPORT

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	36° 59'	122° 17.5'	82	72	123	
trawl	36° 59'	122° 17.5'	82	85	123	SS
CTD	36° 59'	122° 22.5'	128	118	124	
trawl	36° 59'	122° 22.5'	128	85	124	DS
CTD	36° 59'	122° 25.5'	457	445	125	
trawl	36° 59'	122° 25.5'	457	85	125	DS
CTD	36° 59'	122° 35.5'	402	390	126	
trawl	36° 59'	122° 35.5'	402	85	126	DS
trawl	36° 59'	122° 45.5'	1006	85	127	DS
CTD	36° 59'	122° 45.5'	1006	520	127	

DAY: CTD - PESCADERO

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
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CTD	37° 10.7'	122° 28.4'	68	58	1020
CTD	37° 10.7'	122° 40.7'	110	100	1021
CTD	37° 10.7'	122° 53'	421	410	1022
CTD	37° 10.7'	123° 05.3'	869	520	1023
CTD	37° 16.5'	123° 11.4'	1189	520	1024
CTD	37° 22.3'	123° 05.3'	823	520	1025
CTD	37° 22.3'	122° 53'	201	190	1026
CTD	37° 22.3'	122° 40.7'	88	78	1027
CTD	37° 22.3'	122° 28.4'	27	20	1028

NIGHT: TRAWL & CTD - PESCADERO

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	37° 16.5'	122° 34'	82	75	131	
trawl	37° 16.5'	122° 34'	82	85	131	SS
CTD	37° 16.5'	122° 39'	95	85	132	
trawl	37° 16.5'	122° 39'	95	85	132	SS
CTD	37° 16.5'	122° 49'	165	155	133	
trawl	37° 16.5'	122° 49'	165	85	133	DS
CTD	37° 16.5'	122° 59'	549	520	134	
trawl	37° 16.5'	122° 59'	549	85	134	DS
trawl	37° 16.5'	123° 09'	1006	85	135	DS
CTD	37° 16.5'	123° 09'	1006	520	135	

NIGHT: TRAWL & CTD - GULF OF THE FARALLONES

OPS	Latitude	Longitude	Depth(m)	Wire	Out(m)	Station
CTD	37° 47.5'	122° 52'	55	45		139
trawl	37° 47.5'	122° 52'	55	25		139
CTD	37° 42'	122° 54.5'	55	45		138
trawl	37° 42'	122° 54.5'	55	25		138
CTD	37° 35.8'	122° 49.9'	55	45		237
trawl	37° 35.8'	122° 49.9'	55	25		237

DAY: CTD - FARALLONES OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire	Out(m)	Station
CTD	37° 30.8'	122° 59.3'	229		220	1029
CTD	37° 30.8'	123° 11.6'	1280		520	1030
CTD	37° 30.8'	123° 24'	2377		520	1031
CTD	37° 30.8'	123° 36.3'	2652		520	1032
CTD	37° 38.4'	123° 36.3'	3338		520	1033
CTD	37° 46.2'	123° 36.3'	2697		520	1034
CTD	37° 46.2'	123° 24'	1509		520	1035
CTD	37° 46.2'	123° 11.6'	128		118	1036

NIGHT: TRAWL & CTD - FARALLON OUTSIDE

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	37° 39.5'	123° 02.5'	119	110	152	
trawl	37° 39.5'	123° 02.5'	119	85	152	DN
CTD	37° 39.5'	123° 12.5'	1244	520	154	
trawl	37° 39.5'	123° 12.5'	1245	85	154	DN

CTD	37° 44.6'	123° 08.3'	91	81	156	
trawl	37° 44.6'	123° 08.3'	91	85	156	SN
CTD	37° 53'	123° 19'	91	81	160	
trawl	37° 53'	123° 19'	91	85	160	SN
trawl	37° 53'	123° 30'	1463	85	162	DN
CTD	37° 53'	123° 30'	1463	520	162	

DAY: CTD - PT. REYES

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 1.6'	123° 05.5'	64	54	1046
CTD	38° 1.6'	123° 17.8'	119	110	1045
CTD	38° 1.6'	123° 30.1'	137	127	1037
CTD	38° 1.6'	123° 42.4'	2560	520	1038
CTD	38° 1.6'	123° 54.7'	3475	520	1039

NIGHT: TRAWL & CTD - PT. REYES

OPS	Latitude	Longitude	Depth(m)	Wire(m)	Station	Strata
CTD	38° 10'	123° 0'	55	45	165	
trawl	38° 10'	123° 0'	55	25	165	SN
CTD	38° 9.5'	123° 5'	73	63	166	
trawl	38° 9.5'	123° 5'	73	85	166	SN
CTD	38° 10'	123° 10'	91	81	167	
trawl	38° 10'	123° 10'	91	85	167	SN
CTD	38° 10'	123° 17'	128	118	168	
trawl	38° 10'	123° 17'	128	85	168	DN
CTD	38° 10'	123° 22'	183	173	170	
trawl	38° 10'	123° 22'	183	85	170	DN
trawl	38° 10'	123° 29'	285	85	171	DN
CTD	38° 10'	123° 29'	400	390	171	

DAY: CTD - FORT ROSS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 18.5'	123° 10'	83	73	1048
CTD	38° 18.5'	123° 17.8'	110	100	1044
CTD	38° 18.5'	123° 30.1'	275	265	1043
CTD	38° 18.5'	123° 42.4'	1463	520	1042
CTD	38° 18.5'	123° 54.7'	2835	520	1041
CTD	38° 18.5'	124° 07.7'	3600	520	4030
CTD	38° 28'	124° 24.0'	3500	520	4031

NIGHT: TRAWL & CTD - FORT ROSS

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 28'	124° 05'	3350	520	455

trawl	38° 28'	124° 05'	3350	85	455
CTD	38° 28'	123° 42.6'	910	520	454
trawl	38° 28'	123° 42.6'	910	85	454
CTD	38° 28'	123° 23.2'	115	105	453
trawl	38° 28'	123° 23.2'	115	85	453
trawl	38° 28'	123° 14'	53	25	183
CTD	38° 28'	123° 14'	53	43	183

DAY: CTD - NAVARRO

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	38° 50.0'	123° 47.0'	111	100	4032
CTD	38° 50.0'	124° 04'	1805	520	4033
CTD	38° 50.0'	124° 20.0'	3300	520	4034
CTD	38° 50.0'	124° 37.0'	3500	520	4035

NIGHT: TRAWL & CTD - NAVARRO

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	39° 08'	124° 37'	3300	520	465
trawl	39° 08'	124° 37'	3300	85	465
CTD	39° 08'	124° 19'	2000	520	464
trawl	39° 08'	124° 19'	2000	85	464
CTD	39° 08'	124° 00'	500	490	463
trawl	39° 08'	124° 00'	500	85	463
trawl	39° 08'	123° 45.8'	50	25	461
CTD	39° 08'	123° 45.8'	50	40	461

DAY: CTD - DELGADA SOUTH

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	39° 30'	124° 02'	630	520	4036
CTD	39° 30'	124° 17'	1800	520	4037
CTD	39° 30'	124° 35'	2300	520	4038
CTD	39° 30'	124° 53'	2807	520	4039

NIGHT: TRAWL & CTD - DELGADA

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	39° 50'	124° 45'	1300	520	475
trawl	39° 50'	124° 45'	1300	85	475
CTD	39° 50'	124° 24'	1500	520	474
trawl	39° 50'	124° 24'	1500	85	474
CTD	39° 50'	124° 06.5'	300	290	473
trawl	39° 50'	124° 06.5'	300	85	473
trawl	39° 50'	123° 55'	60	85	471
CTD	39° 50'	123° 55'	60	50	471

DAY: CTD - DELGADA NORTH

OPS	Latitude	Longitude	Depth(m)	Wire Out(m)	Station
CTD	40° 05'	124° 15.2'	160	150	4055
CTD	40° 05'	124° 28.3'	678	520	4056



CTD	40° 05 '	124° 41.3 '	1000	520	4057
CTD	40° 05 '	124° 54.3 '	1200	520	4058
CTD	39° 50 '	124° 58 '	1830	520	4059